

the pending claims and an early notification of the allowance of claims 1-8, 10-23 and 25.

The Invention

Disclosed in the subject patent application is a state changeable memory alloy material capable of changing from a first state to a second state upon the application thereto of energy, such as, for example, projected optical beam energy, electrical energy, or thermal energy. The alloy is characterized by a first detectable characteristic when in the said first state and a second detectable characteristic when in said second state. The alloy is further characterized in that the first state comprises a single phase and the second state comprises either a single phase having the same composition as the first phase, or a plurality of phases which have substantially similar crystallization temperatures and kinetics. In one preferred embodiment of the memory alloy claimed herein, the alloy comprises a chalcogenide material which may be formed of at least three elements, such as, tellurium, germanium and antimony. In another preferred embodiment, the memory alloy material of the present invention is a chalcogenide, optical memory alloy which exhibits compositional congruency between an amorphous and a crystalline state. The memory alloy material has a first detectable characteristic (typically, optical reflectivity) when in the amorphous state and a second detectable characteristic when it is in the crystalline state.

By applying the improvement disclosed herein to a multi-layer thin film optical structure, the direction of reflectivity change can be selected by appropriate choice of the layer of memory material and other layer thicknesses. The material is capable of undergoing a congruent state change upon the application of projected beam energy thereto,

most particularly, beam energy in the form of a laser beam. In a write-one system, the material, which is typically amorphous in its as-deposited condition, may be switched typically only once into its crystalline state by a single application of laser light and an energy sufficient to crystallize or initiate crystallization of the material. In this manner, data is recorded onto the material. Alternatively, the material may be written on by switching it from the crystalline to the amorphous state. In erasable systems, the material must be capable of undergoing repeated switching between one state and another. In order to do this, the material is written on by crystallizing or vitrifying it with a laser beam at a first energy and re-vitrifying by erasing it with laser light of a second and different energy. The composition of the memory alloy material claimed herein is selected such that the material maintains compositional congruency between the crystalline and amorphous states. More particularly, when the memory alloy material is in the crystalline state, it includes a major portion which has substantially the same composition as the material in an amorphous state, and a minor portion in which the composition is not too far off the composition of the major portion. Thus, the amount of any single element in the minor portion can vary from the amount of the same element in the major portion by no more than 8 atomic percent. Of course, the same mechanism would be true if the material is switched between different crystalline states.

In a specific embodiment, there is claimed a data storage memory device utilizing the alloy material of the instant invention. The device comprises a substrate, a dielectric first encapsulating layer on the substrate, a layer of memory material formed of

the alloy on the first dielectric encapsulating layer, and a second dielectric encapsulating layer atop the layer of memory material. Optionally, it may further include a layer of optically reflective material, preferably antimony sandwiched between the alloy material and the second encapsulating layer. The data storage memory material may be formed by depositing a substantially uniform composition, the thickness of which is chosen to optimize reflectivity and contrast for a particular application.

The Office Action

In the Office Action of August 9, 1991, claims 1-3 and 5-8 were rejected under 35 U.S.C. §102(b) as anticipated by, or, in the alternative, under 35 U.S.C. §103 as obvious over Koshino, et al. or Young, et al. The Office takes the position that as broadly claimed, the invention is deemed met by the Abstract of Koshino, et al. or Figs. 5A-5B of Young, et al. The Office also opines that the inter-conversion of optical, electrical and thermal energy is well known in the art and, thus, deemed obvious.

Claims 1-4 were further rejected under 35 U.S.C. §112, second paragraph, as indefinite. The Office found that the expressions "capable of" and "detectable characteristics" were vague because of uncertain meanings. The Office found that claim 1 would read on alloys having allotropic transitions and not all combinations of Te, Ge and Sb would work as taught by Applicants, themselves.

Claims 9-23 and 25 were deemed allowable if rewritten in independent form. The expression "first detectable characteristic" in claim 25 was required to be changed to read "first detectable physical characteristic or properties index".

The Instant Amendment

By the instant amendment, Applicants have significantly amended each of the independent claims in precisely the manner suggested by the U.S. Patent and Trademark Office in said Office Action of August 9, 1991. Claim 1 has been amended so as to (1) include all of the subject matter of dependent claim 9 and (2) abide by indefiniteness rejections of other claims and is, therefore, submitted to be in per se condition for allowance. Claim 9 has been cancelled. Claim 10 has been amended in the suggested manner so as to define the first and second detectable characteristics as a first detectable physical characteristic or properties index and a second detectable physical characteristic or properties index. The same change has been made in independent claim 25. Therefore, claims 10 and 25 are also in per se condition for allowance.

Drawings

Submitted concurrently herewith is a new set of formal drawings.

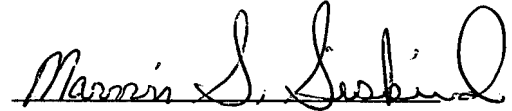
Conclusion

No issues remain. The subject matter of claim 9 has been inserted into independent claim 1 so that claim 1 is in per se condition for allowance. The changes suggested by the Office have been incorporated in both of the other independent claims, claims 10 and 25, so that these claims, as well as claims dependent thereupon are also in per se condition for allowance. There are no outstanding issues. Applicants express their appreciation for the thorough examination given the subject application. Applicants further request that the subject claims, claims 1-8, 10-23 and 25, be reexamined and expeditiously

passed to issue.

Should the Examiner have any further questions or comments which would place the subject patent application in better condition for allowance, he is respectfully requested to contact the undersigned attorney collect.

Respectfully submitted,

A handwritten signature in cursive script, reading "Marvin S. Siskind". The signature is written in dark ink and is positioned above the printed name and registration number.

Marvin S. Siskind

Registration No. 28,153

Date: October 31, 1991

ENERGY CONVERSION DEVICES, INC.

1675 West Maple Road

Troy, Michigan 48084

(313) 280-1900 - Telephone

(313) 280-1456 - Facsimile